Conversion of Fats, Oils, & Greases Into Fuel

Arkansas Alternative Energy Commission

June 21st, 2012

Agenda

- **Background**
- Process Overview
- Product Properties
- Plant Operations

Background: Macro Factors

Throughout the past several years, various governmental mandates (notably RFS 2) emerged to drive energy independence and growth of advanced biofuels

Context

- Initiated RFS mandate in 2009
- Involves a variety of alternative fuels
  - Ethanol (15B), bio-mass based diesel (1B), and cellulosic
  - Anticipated growth over time
- Identifies obligated parties and volume requirements
  - Based on production
  - Significant penalties for non-compliance

Business Challenges

- CapEx needed
- Training
- Geography: Cold weather climates, volatile conditions
- RFS administrative compliance
- Pump labeling for blends >5%

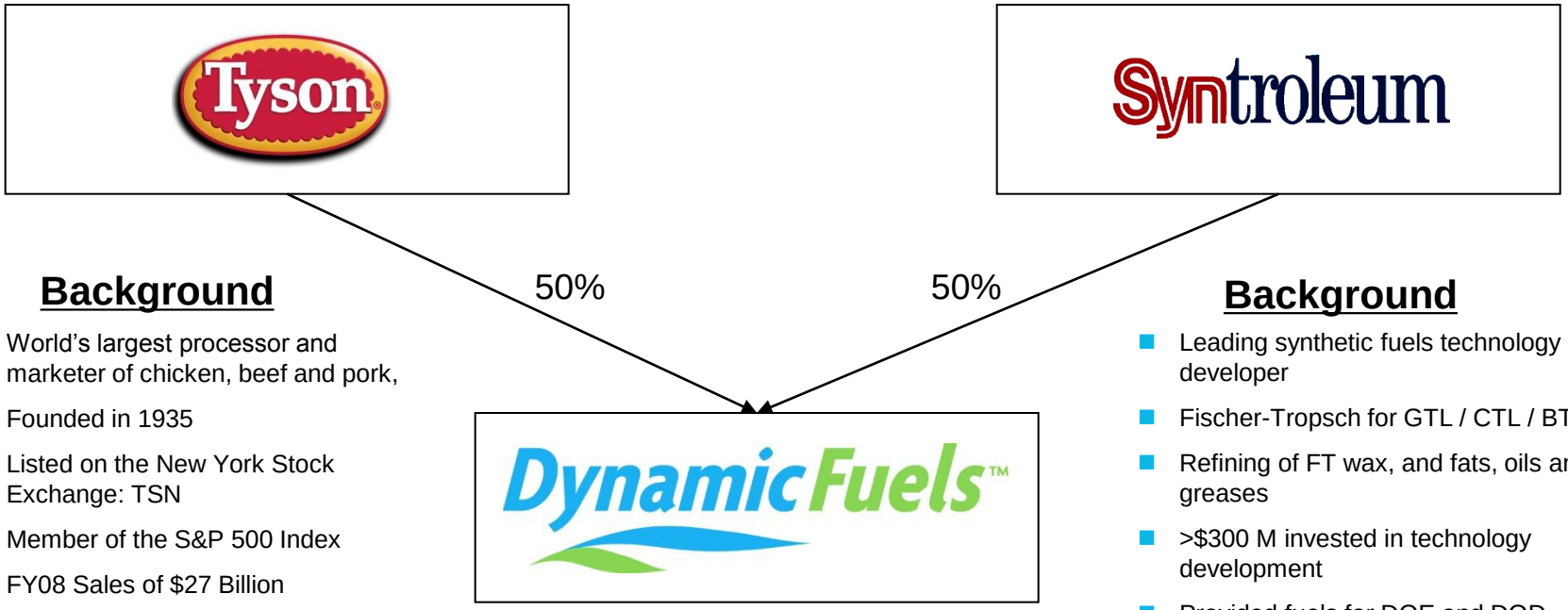
Options Available

1. Avoid compliance
   - $32k+ / day fine, plus
   - Benefit gained
2. Buy RINs
3. Biodiesel
   - High capex (terminal blend)
   - Cold weather training
   - Stability issues
   - Hygroscopic
4. Renewable diesel
   - Low capex (refinery blend)
   - No training needed
   - Highly stable; Not hygroscopic
   - Highest RFS contribution
   - Competitive advantage with downstream / retail customers

Background: Joint Venture Formation

Capabilities Assembled

To capitalize on the opportunity, Tyson and Syntroleum agreed to form a joint venture, Dynamic Fuels



Background

- World's largest processor and marketer of chicken, beef and pork,
- Founded in 1935
- Listed on the New York Stock Exchange: TSN
- Member of the S&P 500 Index
- FY08 Sales of $27 Billion
- >100,000 team members & >100 plants
- Produce in excess of 20,000 bpd of animal fats and greases

Background

- Leading synthetic fuels technology developer
- Fischer-Tropsch for GTL / CTL / BTL
- Refining of FT wax, and fats, oils and greases
- >$300 M invested in technology development
- Provided fuels for DOE and DOD
  - Diesel for fleet testing
  - Certified the B52
  - AF certifying our renewable jet fuel
- 127 US and foreign patents pending / issued

Background: Value Proposition – Feedstock Processing

Dynamic Fuels was designed with the expectation that it could process "low cost" feedstocks, including animal fats oils and greases

Feedstocks

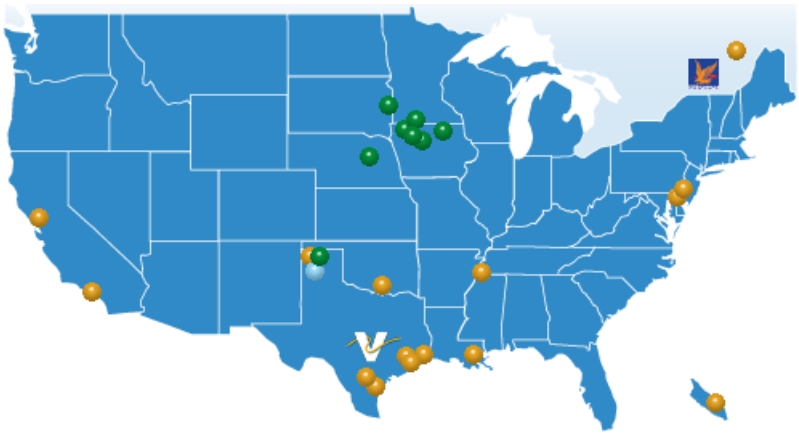
Finished Product

Background: Value Proposition – Obligated Parties

Dynamic Fuels could also meet the requirements of an obligated parties with a "drop in" fuel

Cost Avoidance: SME Biodiesel Integration Cost

	gal / yr
Biomass-based diesel RFS	500 M gal / yr
Company X's share (approx.)	9.6 %
Share of RFS	48 M gal / yr
Minimum terminals needed[1]	10
cost / terminal	$4 M
Total Integration cost	**$40 M**
Integration cost / gal[2]	**8¢ / gal**



Assumptions	*bpd*		*M gal / yr*
Diesel throughput (large terminal)	7,500	→	110
Max % renewable (avoid pump labeling)			5%
Max renewable volume / terminal			5.5

Note: (1) rounded up; (2) assumes 10 year equipment life; RFS shares and capital cost savings are approximate
Source: DOE EIA

Background: Value Proposition – Premium Markets

Eventually, Dynamic Fuels would be able to leverage its unique product properties to "value up" into premium markets

- U.S. Military
  - Aviation fuel
  - Emissions-challenged vehicles
- Commercial aviation
- European refining and marketing companies
  - Shell premium V-Power
- Renewable petrolatum
- Standby generation in California
- Consumer Goods
  - Soaps
  - Detergents
- Blend stock
- R10 (Commodity)

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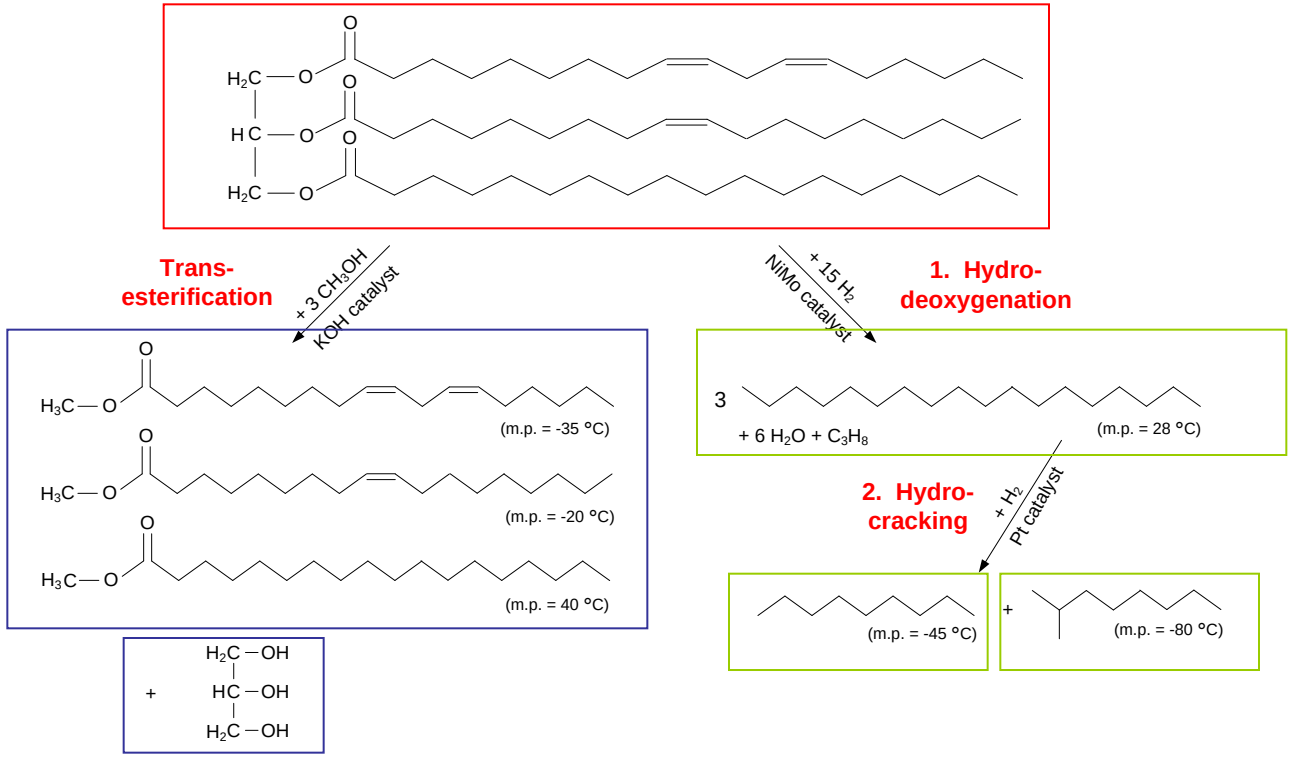
Process Overview: Chemistry

Renewable diesel chemistry is completely different from biodiesel

Animal Fat

Biofuels Production Processes

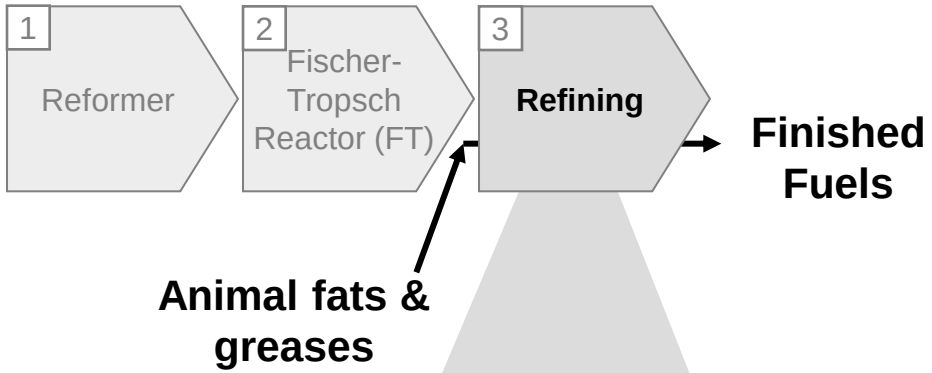


Biodiesel ***Renewable Diesel***

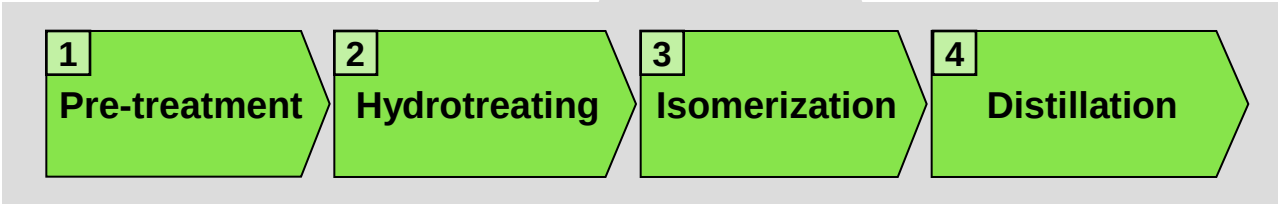
Process Overview: Technology

The fuels production process leverages Syntroleum's core technology suite

Gas-to-Liquids (GTL) Process



Bio-Synfining Process



Removing feedstock contaminants
- water
- metal salts
- other impurities

Process introducing hydrogen with the animal fat to remove (delicately)
- oxygen

Rearranges atoms within the hydro-carbon molecule, changing product properties (cold flow)

Separates components within the liquid
- Diesel 4,100 bpd
- Naphtha 670 bpd
- LPG 530 bpd

Process Overview: Technology

The fuels production process leverages Syntroleum's core technology suite

Gas-to-Liquids (GTL) Process

Future: BTL

1 Reformer → 2 Fischer-Tropsch Reactor (FT) → 3 **Refining** → **Finished Fuels**

Animal fats & greases

Bio-Synfining Process

1 **Pre-treatment** → 2 **Hydrotreating** → 3 **Isomerization** → 4 **Distillation**

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- water
- metal salts
- other impurities

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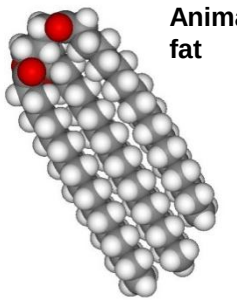
Product: Renewable Diesel vs. Biodiesel Comparison

Only renewable diesel is chemically virtually identical to conventional diesel

Feedstock	Process	Product	Key Takeaway

Feedstock



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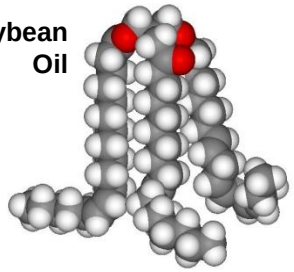
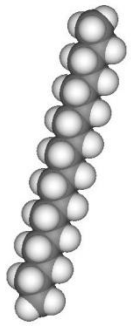


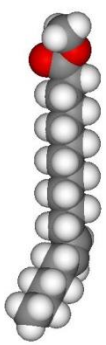
Process

Renewable Diesel
- Combine with Hydrogen
- Hydrotreat & isomerize
- C_3 backbone converted to naphtha and LPG
- Oxygen converted to H_2O

Biodiesel
- Combine with Methanol
- Esterification
- C_3 backbone converted to glycerin

Product





Key Takeaway

- **Chemically identical to the *best* diesel components (no aromatics or olefins)**
- **Meets the diesel spec:ASTM D975**
- **NOT diesel**
- **Does NOT meet the diesel spec**
- **NOT fungible with diesel**

Product: Properties & Specifications Comparison

Renewable diesel is chemically identical to conventional diesel with significant product advantages compared to bio-diesel

		Biodiesel (B100)	Renewable Diesel (R100)	Implications
Product Properties	■ Storage stability[1]	weeks	months / years	Simpler handling
	■ Cloud point	0° C	-20 to -29° C	No heating req'd
	■ Copper strip corrosion	No. 3 max	No. 1	Carbon-steel compatible
	■ Hygroscopic	Yes	No	Simpler handling
	■ Cetane	47	70	Upgrade off-spec diesel & save $$

Note: (1) includes auto-oxidation by air, thermal decomposition by heat, and hydrolysis by water
Source: Dynamic Fuels R-2 S2; REG

Product: Environmental Comparison

In addition, renewable diesel outperforms biodiesel on various environmental properties . . .

		Biodiesel (B100)	Renewable Diesel (R100)	Implications
Environmental Properties	■ NOX emissions	+10%	No change	Non-attainment: ok
	■ Particulate matter	-47%	-96%	Cleaner fuel
	■ PAH emissions (carcinogens)	-80%	-100%[1]	Safer
	■ Carbon Monoxide	-12% (B20)	-16% (R20)	Better for people / environment
	■ Total Unburned Hydrocarbons	-20% (B20)	-48% (R20)	Better for people / environment

Note: (1) expected due to complete saturation
Source: National Biodiesel Board

Product: Integration & Compliance Comparison

. . . and can significantly reduce integration and compliance costs

		Biodiesel (B100)	Renewable Diesel (R100)	Implications
Integration Cost	■ Infrastructure costs	High cost: terminal blending	Low cost: refinery blending	Save time & money
	■ Training	Handling training required	Not needed	Save time & money
RFS Contribution	■ RFS contribution	1.5 / gallon	1.7 / gallon	Cheaper / fewer gallons needed for RFS

Compared to SME, renewable diesel performs better, is simpler to handle, saves time, and saves money

Source: RFS

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Plant Operations: Key Milestones

Dynamic Fuels initiated construction in 2008 and began production in fall 2010

Key Milestones

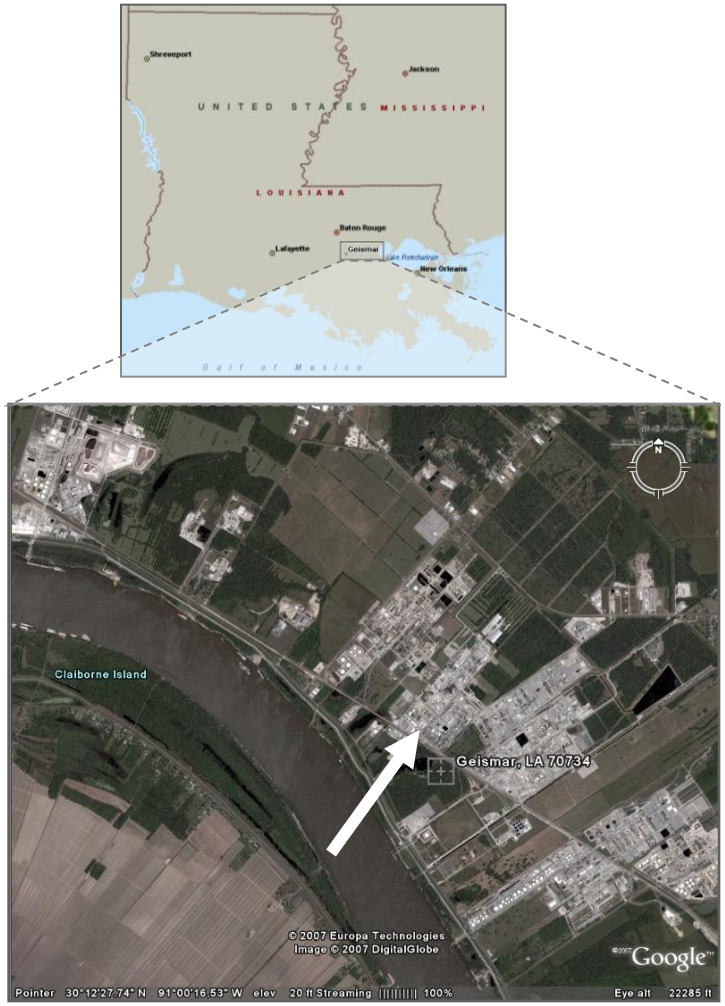
- 11/15/07 Geismar site selected
- 2/28/08 Awarded FEED to CDI Engineering
- 7/11/08 Plant Sanction
- 8//21/08 Awarded construction contract
- 9/9/08 Received Air Permit from LA DEQ
- 10/6/08 Groundbreaking ceremony with Louisiana Governor Bobby Jindal
- 10/21/08 Issued $100M in GO Zone Bonds
- 11/3/08 Began installing site construction offices
- 12/15/08 Poured first concrete foundations
- 11/15/10 Recognized first sale

Pouring tank foundations

Cold separator installation

Plant Operations: Site Overview

Dynamic Fuels' first plant, located on the Mississippi river in Geismar, plugs into existing oil and gas industry infrastructure



Site Details

Site

- Brownfield site: others there include Lion Copolymer, Praxair, Rubicon, Hexion, Crosstex, BASF, Honeywell, Louis Dreyfus, Enterprise, Shell Chemical
- Started construction 2008
- Mechanically complete late 2009
- Begin commercial operations in 2010
- 75M gallons / year of synthetic fuel

Plant Operations: Logistics

Dynamic Fuels has flexibility to meet customer requirements and logistical needs

Typical Questions We Hear	Our Responses
Transportation options?	
• Truck	Yes (preferred)
• Rail	Yes
• Pipeline	Yes
• Barge	Not currently; potentially available
DF Inventory on site?	2 tanks, 40k bbl each
Fuel testing?	Each tank full will be tested by a 3rd party lab, COA provided
Offtake volumes	DF will attempt to accommodate all requests